REINFORCED BOARD

FIELD OF THE INVENTION

[0001] This invention relates to boards, siding, and similar products limited only by imagination of those skilled in the art.

[0002] The invention includes a polyurethane core, unaffected by heat moisture and cold, which may be foamed or unfoamed. The polyurethane is reinforced by feather barbs. Feathers have two portions the quill and barbs growing from the quill. The separated barb portion is used as reinforcement. The product is hard, heat and weather resistant, and has screw retention, flex and tensile strength.

[0003] The invention also includes a process of manufacture of board products comprising the steps of forming and curing a slurry of polyurethane precursors and feather barbs in molds or on conveyors. The polyurethane may foamed during the process.

[0004] Preferably one or both faces of the board are reinforced by fiberglass mats embedded in its surface which are present during curing of the slurry.

[0005] Although the invention is described and referred to specifically as it relates to specific boards and methods of manufacture thereof, it will be understood that the principles of this invention are equally applicable to similar boards and methods of manufacture thereof and accordingly, it will be understood that the invention is not limited to such boards and methods of manufacture thereof.

PRIOR ART

[0006] The closest prior art that applicant is aware of is USP

5,705,030 issued 6 January 1998, Gassner, III, et al., hereby incorporated by reference, who teach processing feathers, principally from chickens, although in principle any feathers can be used. The feathers are cleaned by washing in organic solvent, to remove fat and oil, sanitize, and partly dehydrate the feathers. The barbs or fibers are separated from the quill or shaft by mechanical means to form a fiber pulp. The barbs may be mostly intact and range from 2 cm (0.8 inch) to 4 or 5 cms (1½ to 2 inches) in length. They may also be chopped to 40 or 50 microns (μm) in length. Although not stated by Gassner they are available in 80 micron (μm). Typically chicken flight feathers provide fibers or barbs up to 1½ inches (3¾ cm) long. These feathers can be used in the current invention.

[0007] Feather barbs or fibers are said to have a structure that is of the honey comb type with hexagonal cell structure, which is both very strong and very light. Regardless of this assertion, feather barbs are in fact extremely strong and light, and suitable for use as reinforcement.

BACKGROUND OF THE INVENTION

[0008] Although feather barbs are known attempts to form a reinforced resin board using a mat of chicken feather barbs failed. This was apparently due to failure of the resin to impregnate fully the feather barb mat, leaving voids in the cured reinforced resin. In view of the continuing and almost inexhaustible supply of feathers from poultry slaughtering and processing plants, and that feather barbs are suitable as reinforcing material, a resin board reinforced by feather barbs is desirable.

[0009] It is a principal object of the invention to provide a feather barb reinforced resin board. It is a subsidiary object of the invention to provide a feather barb reinforced

polyurethane resin board. It is a subsidiary object of the invention to provided a feather barb reinforced polyurethane resin board with at least one surface reinforced by an embedded fiberglass mat. It is a subsidiary object of the invention to provided a feather barb reinforced polyurethane resin board with both surfaces reinforced by embedded fiberglass mats. It is a further subsidiary object of the invention to provide a feather barb reinforced foamed polyurethane resin board. It is a further subsidiary object of the invention to provided a feather barb reinforced foamed polyurethane resin board with at least one surface reinforced by an embedded fiberglass mat. It is a further subsidiary object of the invention to provided a feather barb reinforced foamed polyurethane resin board with both surfaces reinforced by embedded fiberglass mats. It is a further principal object of the invention to provide a method of forming a feather barb reinforced resin board by curing a slurry of resin and feather barbs. It is a subsidiary object of the invention to provide a method of forming a feather barb reinforced resin board by curing a slurry of polyurethane resin precursor and feather barbs. It is a subsidiary object of the invention to provide a method of forming a feather barb reinforced resin board by embedding a surface fiberglass mat into, then curing a slurry of polyurethane resin precursor and feather barbs. It is a further subsidiary object of the invention to provide a method of forming a feather barb reinforced resin board by foaming and curing a slurry of polyurethane resin precursor and feather barbs. It is a further subsidiary object of the invention to provide a method of forming a feather barb reinforced resin board by embedding a surface fiberglass mat into, then foaming and curing a slurry of polyurethane resin precursor and feather barbs. It is a further subsidiary object to utilize avian feather barbs, conveniently fowl feather barbs, more preferably waterfowl feather barbs, even more preferably domestic fowl feather barbs, and most preferably domestic waterfowl feather barbs. Other objects will be apparent to those skilled in the art from the following specification,

accompanying drawings and appended claims.

DESCRIPTION OF THE INVENTION

[0010] In one broad aspect the invention is directed to a cured resin board reinforced by feather barbs. Preferably the resin is polyurethane resin, more preferably foamed polyurethane resin. Preferably the board has a fiberglass mat embedded in at least one surface, more preferably both. The polyurethane may contain crosslinking agents, fillers, dyes, pigments, reinforcing agents, and similar additives as known to those skilled in the art. When foamed the polyurethane resin typically has densities of from about 5 to 10 lbs/cubic foot, or from about 0.08 to about 0.16, densities can vary from 1½ to 62½ lbs/cubic foot, or from about 0.025 (highly foamed) to about 1 (solid). While the feather barbs are preferably those from flight feathers having lengths in the case of chicken feathers up to about 1½ inches (3¾ cm), other feathers may be used, such as duck, geese and turkey flight feather barbs, which are longer, body feather barbs which are shorter, and chopped feather barbs, which may be as short as 80 microns (μm) or even shorter. Feather barbs from just about any species however exotic may be used, Grassman for example refers to ostrich and peacock feather barbs. As those skilled in the art are aware the commonest available feather barbs are those from domestic poultry used for food. Any avian feather barbs, conveniently fowl feather barbs, more preferably waterfowl feather barbs, even more preferably domestic fowl feather barbs, and most preferably domestic waterfowl feather barbs may be used. The boards may vary from about ¼ inch (6 mm) thick in the case of solid polyurethane resin, although it can be about 3/16 inch (5 mm) thick, having two fiberglass mats about 1/32 inch (0.8 mm) thick each, with a solid core about ⅛ inch (3 mm) up to about 1 inch thick, and about ¼ inch (6 mm) in the case of foamed polyurethane resin, up to 6 inches (15 cm) thick, in general the thicker the board the more foamed it is (the higher the foam

content). The proportions of feather barbs is calculated by relative volume as mixed with the slurry, since the feather barbs are extremely light compared with the resin. In practice proportions by volume of from about 5% up to about 80% by volume of the resin-feather barb mixture have been found satisfactory by strength tests. Addition of feather barbs have been found to improve tensile strength, and screw resistance, to make the product light weight, and to make significant cost savings. Screw resistance is of significance in broadening application of the boards. Embedding a fiberglass mat throughout a surface of the board improves flex resistance considerably, generally both surfaces are so reinforced, but this is not necessary in every application. In general the resin itself, without feather barb reinforcement or fiberglass mat surface reinforcement is too brittle.

[0011] In another broad aspect the invention is directed to a method of manufacture of a board comprising the steps of forming a slurry of resin components and feather barbs, placing the slurry in a mold, closing the mold, and curing the resin components in the mold. Preferably the slurry comprises polyurethane precursors and feather barbs. More preferably a fiberglass mat is placed in the mold, then saturated with polyurethane precursors, the polyurethane precursors-feather barb slurry is then placed in the mold on the fiberglass mat. The polyurethane precursors-feather barb slurry may contain blowing agent, in which case the polyurethane precursors are cured and foamed. Even more preferably a second fiberglass mat is placed on the slurry and saturated with polyurethane precursors. A variant of this process involves placing a first fiberglass mat on a first lower conveyor belt (typically metal, preferably stainless steel) then spraying polyurethane precursors on the mat to saturate it, then spraying polyurethane precursors-feather barb slurry which may contain blowing agent on the first fiberglass mat. A second fiberglass mat is then placed on the

slurry and sprayed with polyurethane precursors. A second upper conveyor belt (likewise typically metal, preferably stainless steel) contacts the second fiberglass mat. The polyurethane precursors are cured between the conveyor belts. When blowing agent is present, the polyurethane is simultaneously foamed. Preferably process and curing and, if applicable, foaming are performed at 100°F (38°C), which reduces viscosity from about 600 centipoise at room temperature to about 100 centipoise.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] Fig. 1 shows a sectional view of a preferred embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0013] Numeral 10 indicates a reinforced board of the invention, which has a polyurethane resin core 12, reinforced by chicken feather barbs, and optional surface fiberglass mats 14 and 16 impregnated with polyurethane resin which is integrally bonded to the polyurethane core. The boundaries shown between layers 14 and 16 containing mats and core 12 containing feather barbs represent a change of composition only, the polyurethane resin itself is continuous and identical throughout the layers. The polyurethane core may be composed of polyurethane resin, which may be foamed or unfoamed, when foamed the polyurethane is 5 or 10 lbs/cubic foot (density 0.08 or 0.016), although it can be as foamed as light as 1½ lbs/cubic foot or solid 62½ lbs/cubic foot (density 0.25 to 1). The polyurethane core is composed of a cured mixture of polyurethane precursors (polyols and polyisocyanates) and feather barbs, the feather barbs comprising from 5% to 80% by volume of the mixture. 5%, 10%, 20%, 30%, 40%, 50%, 60%, 70% and 80% mixtures were formed. It as obvious from inspection, that 80% by volume of chicken feather barbs was approaching the limit of practicality. Mixtures were made both

without foaming (blowing) agents and with both 5 and 10 lbs/cubic foot foams were manufactured in a mold 4 x 9 feet (1.2 x 2.7 meters) and ¼ inch (6 mm) thick. The volume of feather barbs in the foamed polyurethane was calculated by relative volume as mixed with the original slurry. Fiberglass mats weighing ½ to 1 ounce/square yard (about 17 to 34 g/sq. meter), were saturated by spraying with the same polyurethane precursors as mixed with the chicken feather barbs, one was placed in the bottom of the mold which was then filled with a slurry of polyurethane precursors and chicken feathers, the other placed on the top of the slurry, which was then cured in the closed mold. Heavier fiberglass mats can be used, there is no basic restriction. The process of manufacture is fast the spraying of the fiberglass mat in the mold takes seconds, as does the mixing and spraying of the chicken feather barb-polyol-polyisocyanate slurry with conventional additives such as catalysts, etc., with/without blowing agents. The polymerization (and blowing) process takes about 30 seconds, and is mostly complete within a further 30 seconds. The board is then cured for about a day (24 hours). The polyurethane foamed or otherwise neither shrinks nor expands during curing/hardening stages. In mass production the fiberglass mat would be placed on a conveyor some 4 or 5 feet (1.2 to 1.5 meters) wide, sprayed with polyurethane precursors mixture, then the polyurethane precursors-feather barb slurry would be poured or sprayed onto the bottom fiberglass mat. A top fiberglass mat is then placed on the slurry, which would then be sprayed in turn with polyurethane precursors. A second upper conveyor belt then contacts the upper saturated fiberglass mat and the whole is then cured between the conveyor belts. The process of molding and curing is generally carried out at 100°F (38°C), which reduces resin precursor viscosity to about 100 centipoises. It is believed, without prejudice, that the use of the same polyurethane precursors bound the fiberglass mats integrally to the polyurethane core, transforming the layers into an integral composite board. The fiberglass mat reinforced

board, can have a solid chicken feather barb reinforced polyurethane core as thin as ⅛ inch (3 mm), while the fiberglass mat reinforced layers can be as thin as 1/32 or 1/16 inch (0.8 or 1.6 mm). A ½ inch (13 mm) board of the current invention is about as strong as a ¾ inch (19 mm) plywood board and lighter in weight. The boards were tested, by a 250 lb (115 Kg) man (applicant) jumping up and down on square foot samples, which were found to deform less the greater the volume of chicken feather barbs, although not quantitative the deformation was less with more chicken feather barbs. Samples of the boards were also more scientifically tested by placing a 50 pound (22½ Kg) weight on a 3½ foot square (meter square) board ¼ inch (6 mm) thick and measuring the deflection, ⅝ inch (16 mm) deflection was noted at 5% barb volume, less with more. Again not quantitative but strongly indicative of increased tensile strength. The fiberglass mats increased the flexural strength of the boards, by indicative but not quantitative measurement. Similar indicative testing demonstrated superior screw retention by the chicken feather barb reinforced boards.

[0014] As those skilled in the art would realize these preferred described details and materials and components can be subjected to substantial variation, modification, change, alteration, and substitution without affecting or modifying the function of the described embodiments.

[0015] Although embodiments of the invention have been described above, it is not limited thereto, and it will be apparent to persons skilled in the art that numerous modifications and variations form part of the present invention insofar as they do not depart from the spirit, nature and scope of the claimed and described invention.